



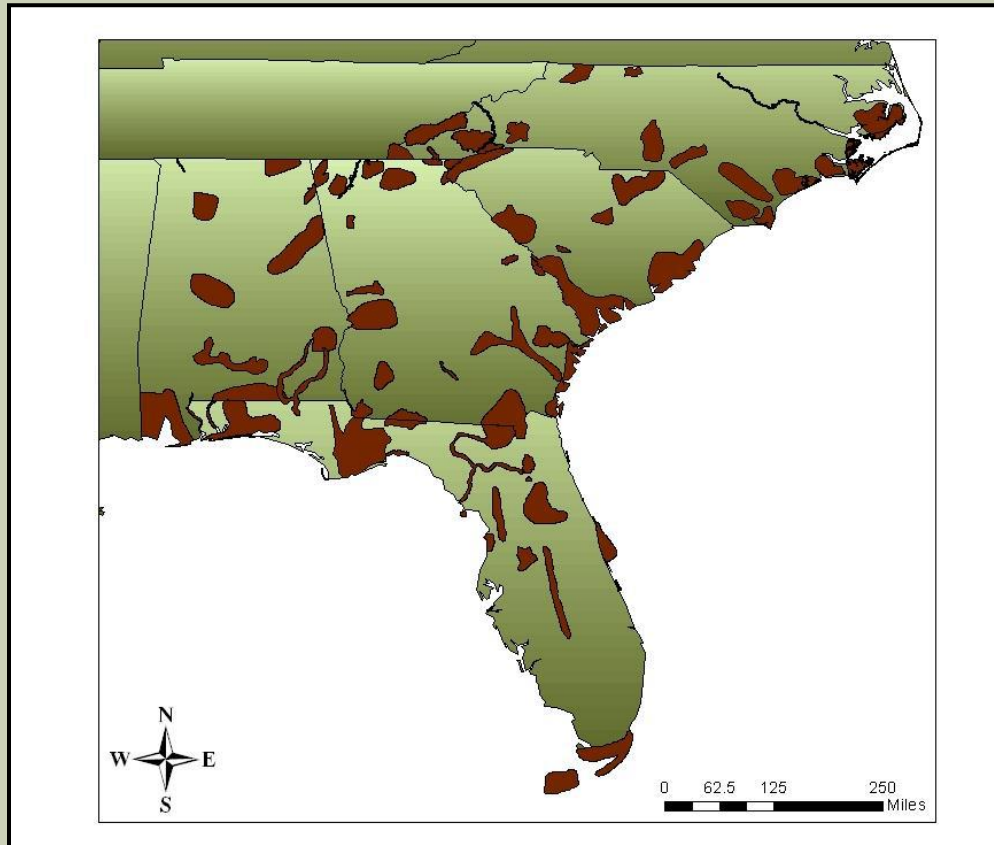
# DETERMINING VULNERABILITY OF PARCAs IN THE NORTH ATLANTIC LCC TO CLIMATE CHANGE

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DeMaynadier, and P. Nanjappa

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# PRIORITY AMPHIBIAN AND REPTILE CONSERVATION AREAS (PARCA)



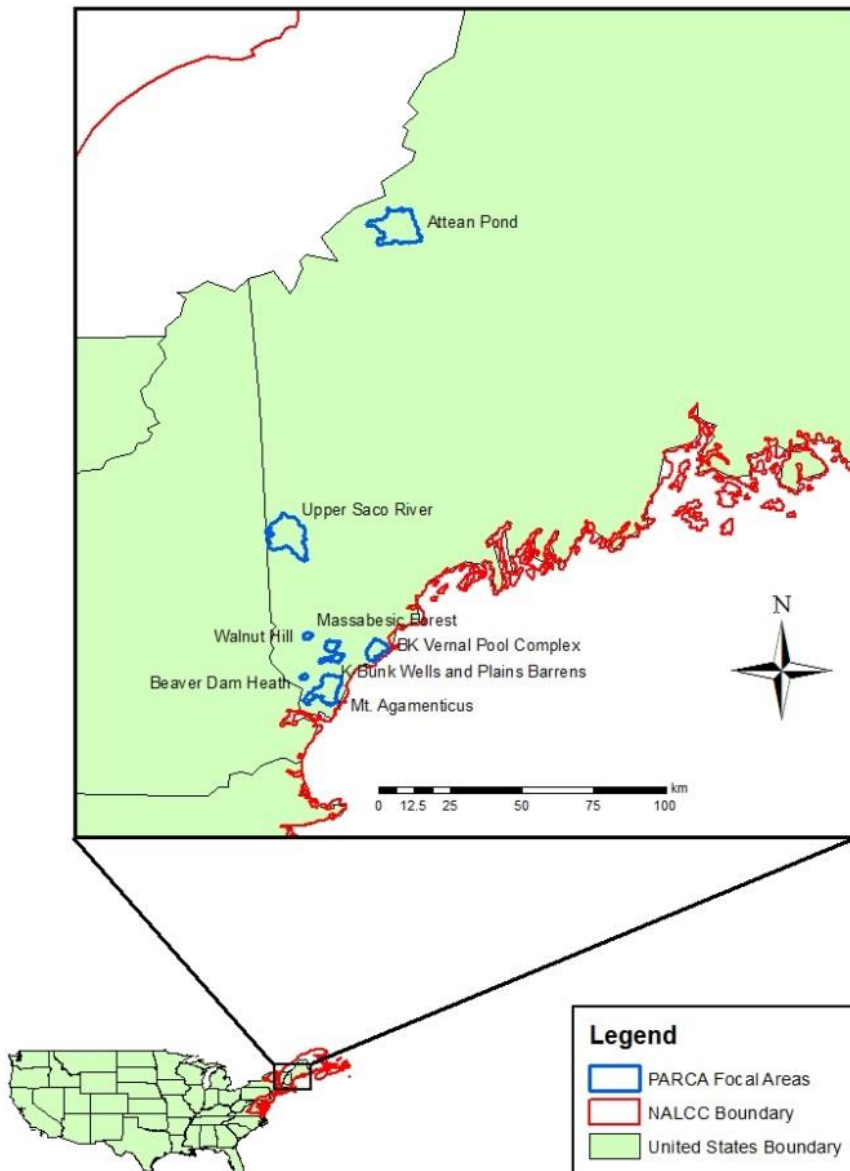
- Landscape-scale conservation
- Amphibian- and reptile-specific
- Maximize “Bang for your buck”
- Preliminary designation results from herp assemblage (priority species and biodiversity considerations)
- Areas with poor landscape integrity are removed secondarily

(Speare, Apodaca, and Jenkins, 2013)

## MAINE PSEUDO – PARCAS

1. Attean Pond
2. Upper Saco River
3. Walnut Hill
4. Beaver Dam Heath
5. Mt. Agamenticus
6. Kennebunk Plains and Wells Barrens
7. Massabesic Forest South
8. Biddeford Kennebunk Vernal Pool Complex

- Areas likely to comprise PARCAs in the future
- Provide practice sites to evaluate data layers



# PRIMARY PROBLEM AND OBJECTIVE

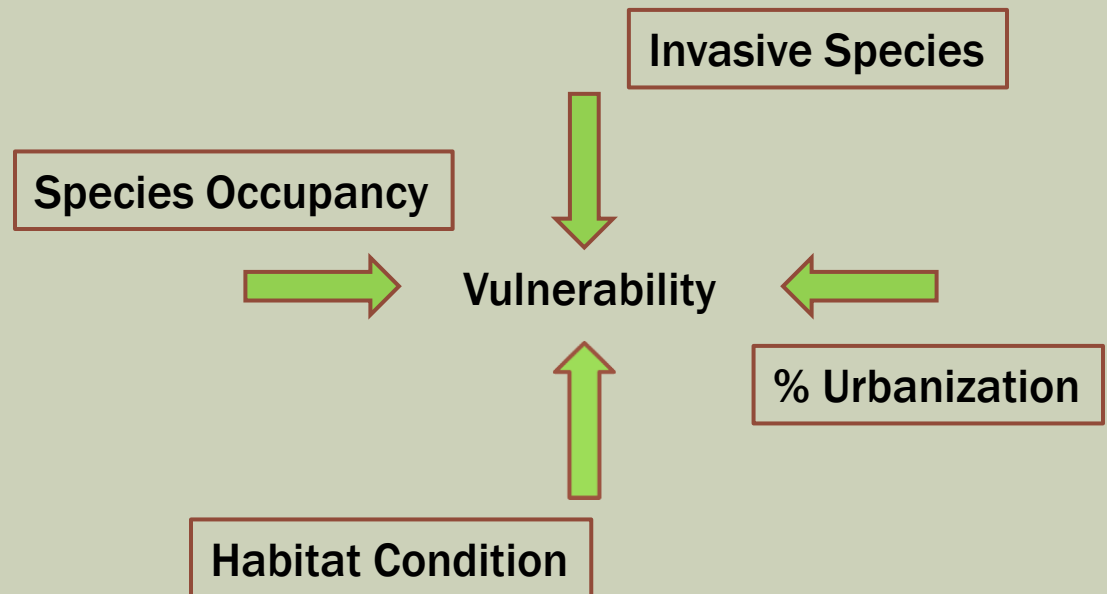
**Problem:** primary target areas for conservation face multiple ongoing and future threats. How should these threats influence decisions that involve the areas?

## **Objective:**

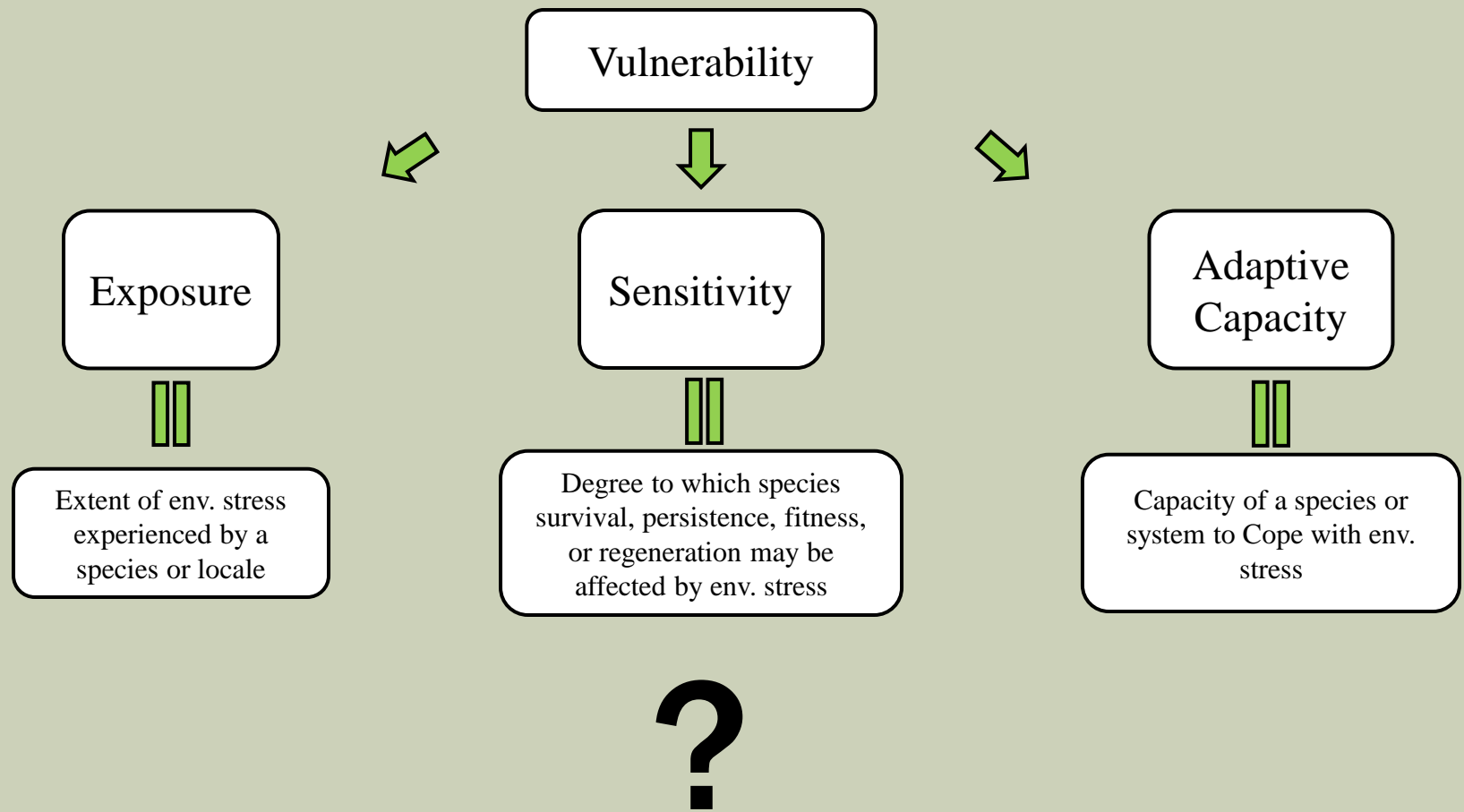
- 1.** Synthesize elements of vulnerability to yield an overall assessment.
- 2.** Evaluate individual elements for management and conservation insights.

# VULNERABILITY ASSESSMENT

- Requires monitoring of multiple aspects of the environment
- Evaluation of environmental health from multiple perspectives



# VULNERABILITY – COMBINING THE ELEMENTS



(Kelly and Edgar 2000; Magness et al. 2011)

# VULNERABILITY – COMBINING THE ELEMENTS

esa

ECOSPHERE

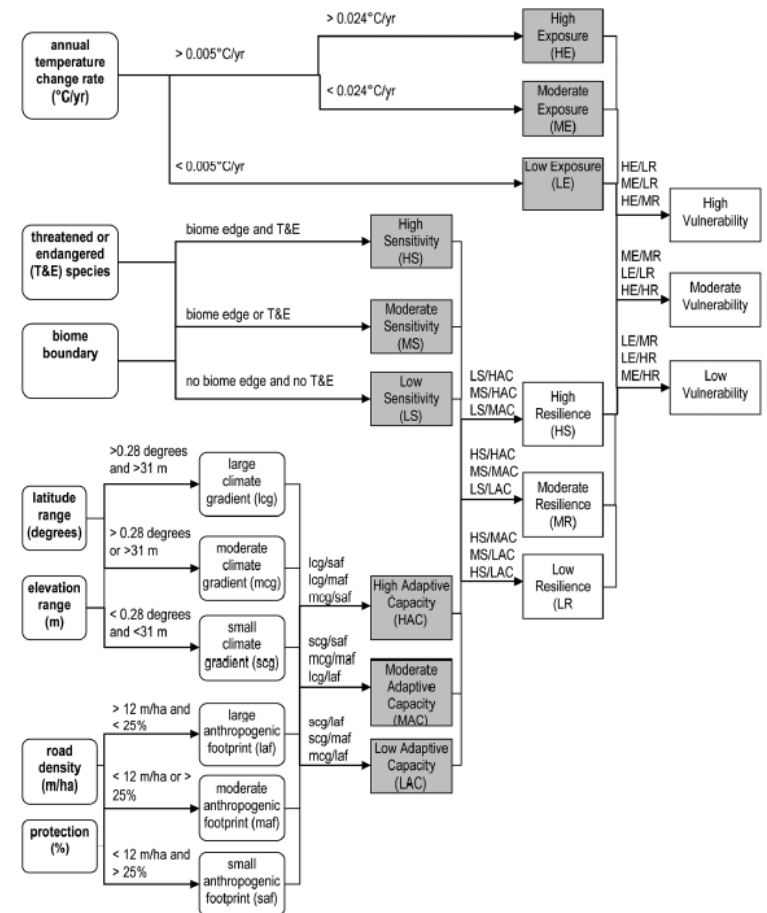
A climate-change adaptation framework to reduce continental-scale vulnerability across conservation reserves

DAWN R. MAGNESS,<sup>1,2,†</sup> JOHN M. MORTON,<sup>1</sup> FALK HUETTMANN,<sup>2</sup> F. STUART CHAPIN, III,<sup>2</sup>  
AND A. DAVID MCGUIRE<sup>2</sup>

## National Wildlife Refuge System



(Kelly and Edgar 2000; Magness et al. 2011)



# FRAMEWORK ATTRIBUTES

## Exposure:

- Projected Temperature Change by 2050 (Climate Wizard: A2A Ensembled Scenario)
- Projected Precipitation change by 2050 (Climate Wizard: A2A Ensembled Scenario)
- Projected % Urbanization (2006 NLCD)
- Projected 1 m Sea-Level Rise (Bathtub model)

## Sensitivity:

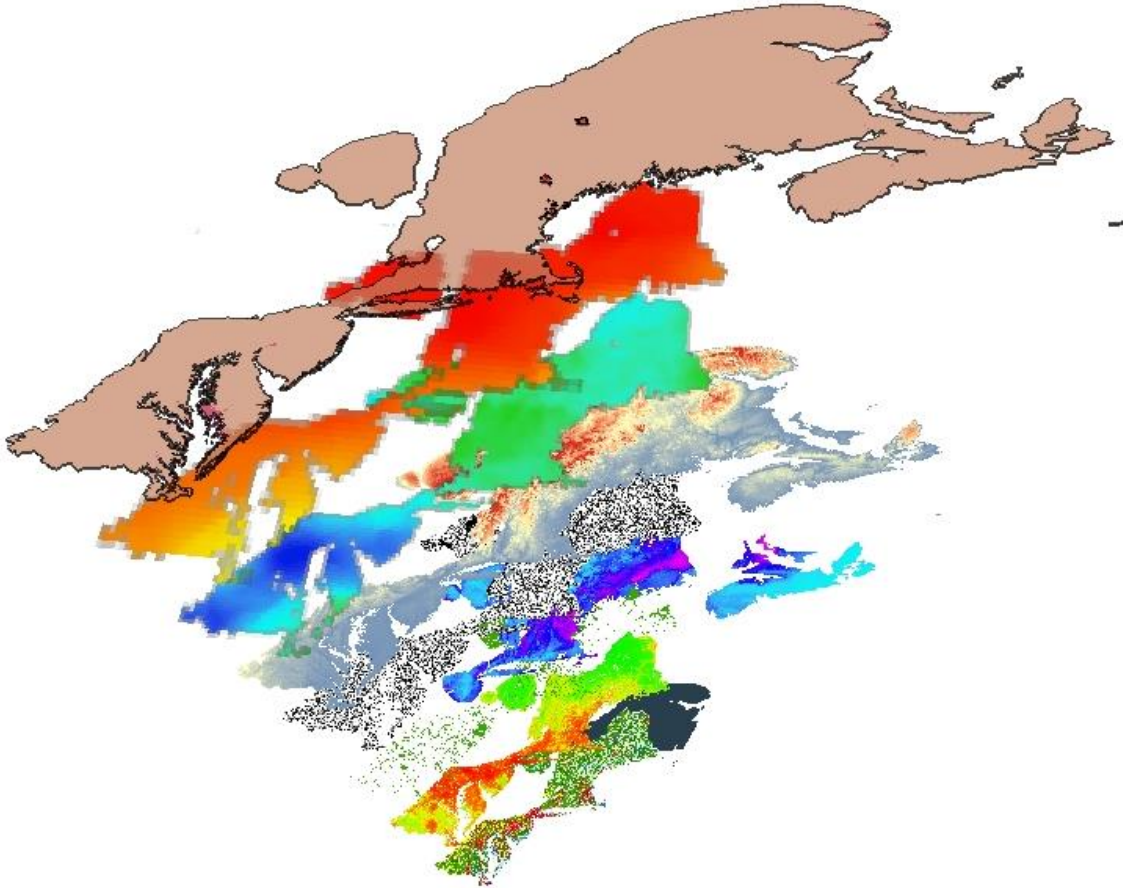
- Priority Species Endemicity ( $\Sigma(1/\text{range size km}^2)$ )
- Average Projected Priority Species Loss by 2050 (Maxent Models; Current vs. Projected)
- Distance to Nearest Ecoregion Boundary (Based on Centroid)
- Management Effort to Maintain Priority Habitats (Expert Opinion)

## Adaptive Capacity:

- Variation in Elevation
- Size of PARCA (ha<sup>2</sup>)
- Hillshade (Slope and Aspect Indicator: 45° sun angle at 225°) to indicate NE slopes
- Percent Protected Areas (PA) and Natural Landscapes (NL; avg.)
- Landscape Connectivity (% PA and NL [0.50] in Buffer [10 km])
- Habitat Complexity (Diversity of Landscape-Scale Habitats)

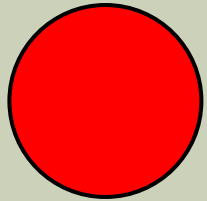


# VULNERABILITY ASSESSMENT DATA LAYERS

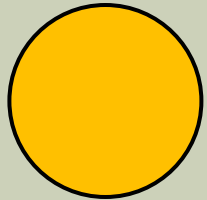


1. NALCC Boundary
2. Level III Ecoregions
3. Proj. 1m Sea-Level Rise
4. 2050 Temp. Change A2A Proj.
5. 2050 % Precip. Change A2A Proj.
6. Elevation
7. Hillshade
8. Species Distribution Models
9. Protected Areas
10. 2030 Natural Landscapes
11. 2006 LULC Data

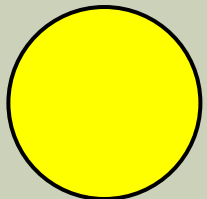
# VULNERABILITY AND ATTRIBUTE SCORING



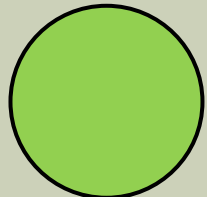
**High Vulnerability**



**Moderate/High Vulnerability**



**Low/Moderate Vulnerability**



**No/Low Vulnerability**

- **Modified “stop-light” scoring analogy**
- **Scores for each metric standardized on a scale of 0 – 3**
- **Thresholds for each metric developed based on expert opinion**
- **Each metric averaged to determine exposure, adaptive capacity, and sensitivity**

## Exposure

% Anthropogenic Landuses

High Exposure (> 10%)

Mod/High Exposure (5-9%)

Low/Mod Exposure (2.5-4%)

No/Low Exposure (< 2.5%)

Avg. + other  
aspects of  
exposure

Vulnerability = Exposure - Resiliency

## Sensitivity

Range Loss of Priority Species

High Sensitivity (> 30%)

Mod/High Sensitivity (10 - 29%)

Low/Mod Sensitivity (5 - 9%)

No/Low Sensitivity (0 - 4%)

Avg. + other  
aspects of  
sensitivity

Resiliency = Adaptive Capacity - Sensitivity

## Adaptive capacity

% Protected Areas

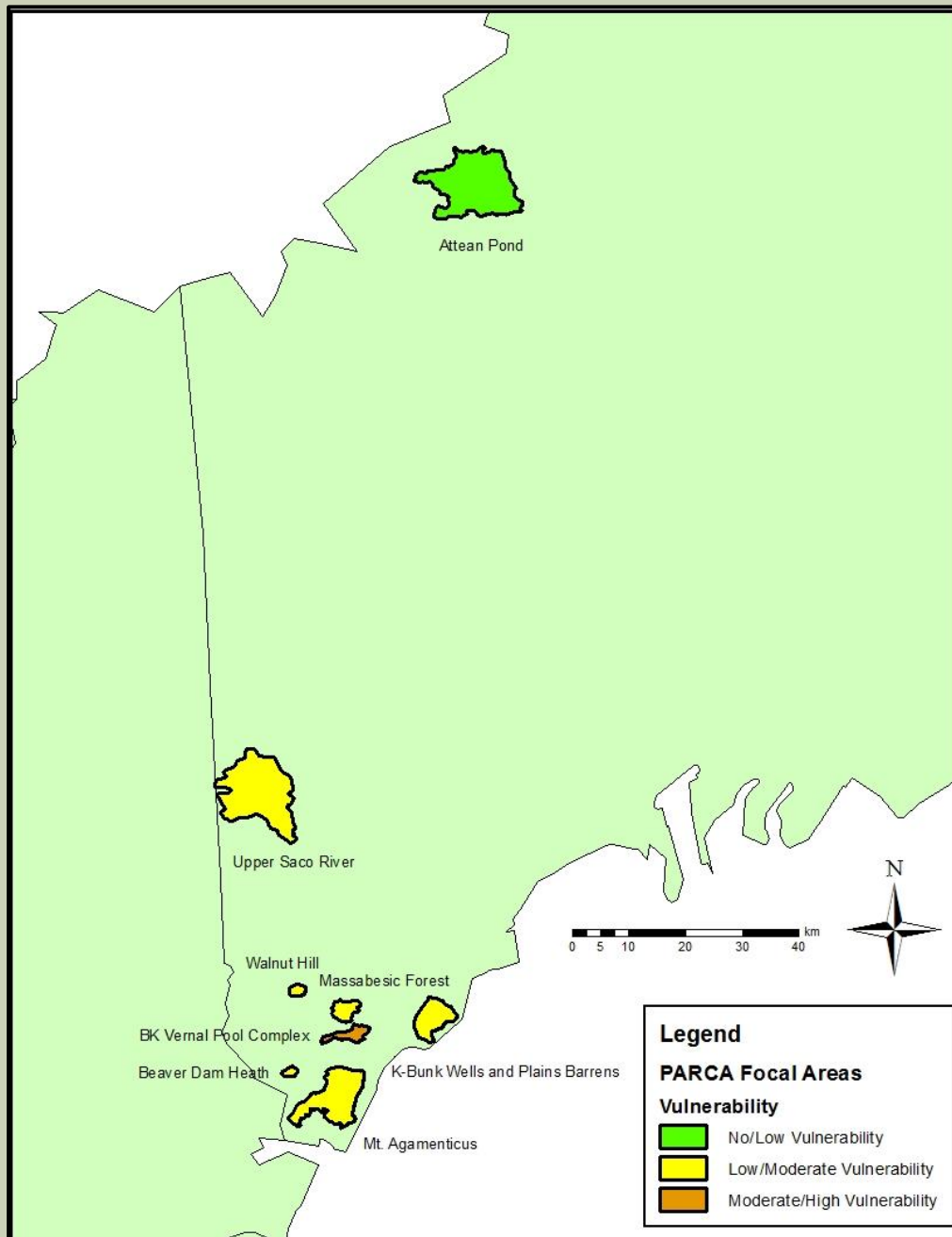
High Adaptive Capacity (> 50%)

Mod/High Adaptive Capacity (25 - 49%)

Low/Mod Adaptive Capacity (10 - 24%)







































No/Low Adaptive Capacity (0 - 9%)

Avg. + other  
aspects of AC



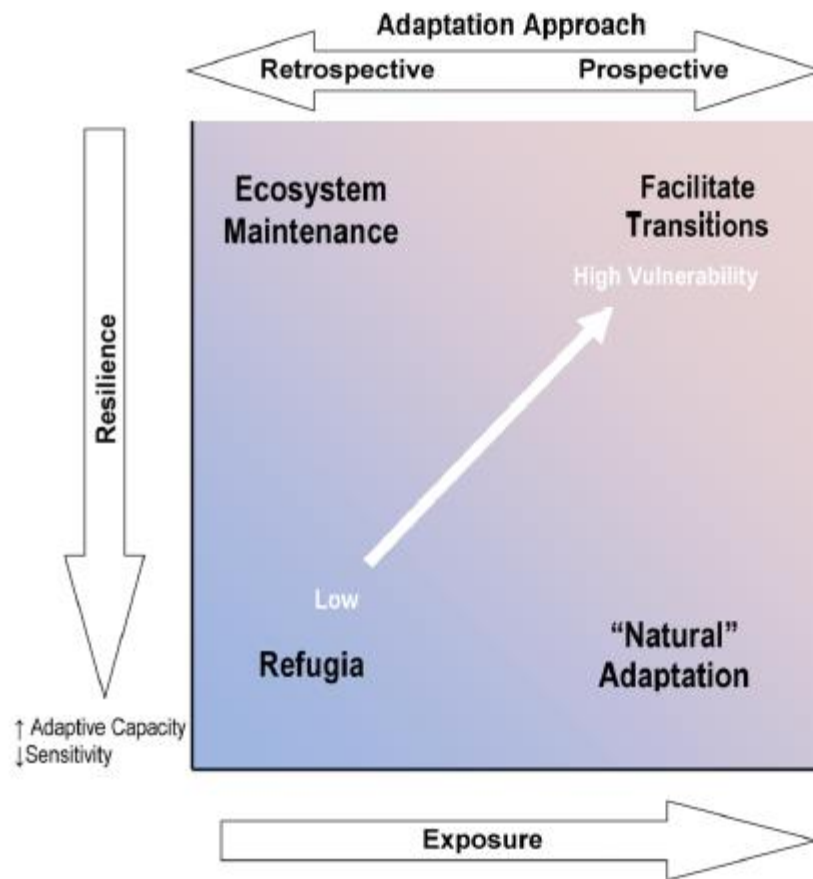
## VULNERABILITY OF THE LANDSCAPE

- Eight total PARCAs assessed
- Attean Pond (Low Vulnerability)
- Six out of eight PARCAs (Low/Moderate Vulnerability)
- One out of eight PARCAs (Moderate/High Vulnerability)
- No High Vulnerability PARCAs

|  | Attean Pond   | K-B Wells Plains B  |
|--|---|---|
| <b>VULNERABILITY</b>                         |     |     |
| <b><u>Exposure</u></b>                       |    |    |
| • Projected Temperature Change               |    |    |
| • Projected Precipitation Change             |    |    |
| • Projected 1m Sea-Level Rise                | NA  | NA  |
| • % Urban Landuse                            |    |    |
| <b><u>Adaptive Capacity</u></b>              |    |    |
| • Elevation Variation                        |    | →  |
| • PARCA Size                                 |    |    |
| • Hillshade                                  |    |    |
| • % Protected Areas                          |    |    |
| • Projected Natural Landscape                |    | →  |
| • Landscape Connectivity (%PA in Buffer)     |    |    |
| • Landscape Connectivity (%NL in Buffer)     |    | →  |
| • Habitat Heterogeneity (Diversity)          |   |   |
| <b><u>Sensitivity</u></b>                    |  |  |
| • Distance to Ecoregion Boundary             |  |  |
| • Loss of Climate Envelope (Priority Amphs.) |  |  |
| • Loss of Climate Envelope (Priority Reps.)  |  |  |
| • Priority Species Endemicity                |  |  |
| • Management Effort (Sensitive Habitats)     | NA  | NA  |

# MANAGEMENT STRATEGIES

MAGNESS ET AL.



# WHAT THIS FRAMEWORK DOES

- Provides stakeholders with a tool to evaluate PARCA vulnerability across the landscape
- Provides a method to incorporate multiple stressors and biological components as needed
- Thresholds can be adjusted based on increased knowledge of the system
- Provides multiple levels of information
  - Metric level
  - Exposure, sensitivity, adaptive capacity, and resiliency
  - Vulnerability

# WHAT THIS FRAMEWORK DOES NOT DO

- May not be best proxy to determine biological importance of habitats
- In current state may not say adequately capture climate buffering aspects of microhabitats
- Does not predict species loss, just loss of climate envelope
- Does not consider variable importance – all aspects are equal



# ACKNOWLEDGEMENTS

- USFWS North Atlantic LCC for financial support
- NEPARC for financial and intellectual support
- S. Speare and J. Apodaca for ideas on assessing vulnerability



# FUTURE GOALS

- Finalize thresholds for individual metrics
- Determine the role of expert opinion for determining mgmt. effort
- Evaluate vulnerability of finalized PARCAs throughout the NALCC; range-wide maps
- Examine trends by state and ecoregion

